CONTENTS

KEYNOTES

E.G. Thompson, O. Hamzeh, L.A. Jackman and S.K. Srivatsa
A QUASI-STEADY-STATE ANALYSIS FOR RADIAL FORGING 1

J.-L. Chenot
RECENT CONTRIBUTIONS TO THE FINITE ELEMENT MODELLING OF METAL FORMING PROCESSES 9

O. Pawelski
WAYS AND LIMITS OF THE THEORY OF SIMILARITY IN APPLICATION TO PROBLEMS OF PHYSICS AND METAL FORMING 19

R. Kopp and U. Zitz
STRATEGY FOR CRACK AVOIDANCE DURING METAL-FORMING, ILLUSTRATED BY THE CASE OF HAMMER FORGING 31

A. Korbel
PERSPECTIVES OF THE CONTROL OF MECHANICAL PERFORMANCE OF METALS DURING FORMING OPERATIONS 41

R.N. Wright
STRESS RELAXATION ANALYSIS IN COLD ROLLED SHEET 51

NUMERICAL MODELLING

S.M. Roberts, F.R.Hall, A. Van Bael, P. Hartley, I. Pillinger, C.E.N. Sturgess, P. Van Houtte and E. Aernoudt
BENCHMARK TESTS FOR 3-D, ELASTO-PLASTIC, FINITE-ELEMENT CODES FOR THE MODELLING OF METAL FORMING PROCESSES 61

B. Glut, T. Coupez and J.-L. Chenot
AUTOMATIC MESH GENERATOR FOR COMPLEX 2D DOMAINS-APPLICATION TO MOVING GEOMETRIES IN FORMING PROCESSES 69

A. Forcellese, F.Gabrielli, F.Micari and O.Zurla
FINITE ELEMENT MODELLING OF ISOTHERMAL FORGING OF A HIGH STRENGTH ALUMINIUM ALLOY 77

J.G. Lenard, Z. Malinowski and M. Pietrzyk
COMPARISON OF THE PREDICTIVE CAPABILITIES OF MATHEMATICAL MODELS OF THE FLAT ROLLING PROCESS 85

O. Maillard, P.Montmitonnet and P.Lasne
SIMULATION OF COLD FORGING BY A 2D ELASTOPLASTIC FINITE ELEMENT METHOD WITH AUTOMATIC REMESHING 93

T. Reinikainen, K. Andersson, S. Kivivuori and A.S. Korhonen
FINITE-ELEMENT ANALYSIS OF COPPER EXTRUSION PROCESSES 101

W. Sosnowski, E.Onate and C. Agelet de Saracibar
COMPARATIVE STUDY ON SHEET METAL FORMING PROCESSES BY NUMERICAL MODELLING AND EXPERIMENT 109

P. Boisse, J.L. Daniel and J.C. Gelin
NUMERICAL SIMULATIONS OF 3D SHEET METAL FORMING EMPLOYING NEW AHMAD SHELL FINITE ELEMENTS 117

F. Aberlenc and J.-L.Babeau
OPTRIS AND FICTURE: INDUSTRIAL TOOLS TO MODELIZE SHEET METAL FORMING 125

Z. Kampus and K. Kuzman
EXPERIMENTAL AND NUMERICAL (FEM) ANALYSIS OF DEEP DRAWING OF RELATIVELY THICK SHEET METAL 133

C. Gay, P. Montmitonnet, N. Soyris and J.L. Chenot
VALIDATION OF A 3-D FINITE ELEMENT PROGRAM COUPLED WITH AUTOMATIC REMESHING 141

B. Kukuryk
THE INFLUENCE OF FORGING CONDITIONS ON MAGNITUDE AND DISTRIBUTION OF STRAINS IN DRAWING-DOWN 149

R. Szyndler and B. Klimkiewicz,
DESIGN OF THE OPEN-DIE ELONGATION PROCESS USING OPTIMIZATION TECHNIQUE 157

J.F. Boujut and S. Tichkiewitch
A STEP TOWARD AUTOMATIC DRESSING OF A THREE-DIMENSIONAL STAMPED PART 163

PLASTICITY, MECHANICAL PROPERTIES AND FRICTION

A.Farzad and T.Z. Blazynski
REDUNDANCY EFFECTS IN THE EXTRUSION OF ROUND BARS INTO I-SHAPED DIES 173

A.Z. Kocanda and B. Raddad
ELASTO-PLASTIC DEFORMATION BEHAVIOUR AND FRACTURE OF RING-SHAPED DIES 181

K. Pohlandt and T. Oberlander
CONCEPTS FOR THE DESCRIPTION OF PLASTIC ANISOTROPY IN COLD BULK METAL FORMING 187

K. Miyauchi
DEFORMATION PATH EFFECT ON STRESS-STRAIN RELATION IN SHEET METALS 195

B. Avitzur
THE UPPER BOUND APPROACH TO THE FRICTION WAVE MODEL 201

J. Elfmark and P. Stanek
ANALYSIS OF TENSILE TEST BEYOND THE ULTIMATE TENSILE STRENGTH 211

J. Sinczak, J. Kusiak, W. Lapkowski and R. Okon
THE INFLUENCE OF DEFORMATION CONDITIONS ON THE FLOW OF STRAIN RATE SENSITIVE MATERIALS 219

I. Schindler, J. Kliber and J. Boruta
STUDY OF CONCAST STEELS PLASTICITY IN LOW-TEMPERATURE REGION 225

T. Sobis, U. Engel and M. Geiger
A THEORETICAL STUDY ON WEAR SIMULATION IN METAL FORMING PROCESSES 233

A. Maranda, J. Nowaczewski and W. Przetakiewicz
EXPLOSIVE STRENGTHENING OF THE SURFACE LAYER IN St72P STEEL RAILS 241

ROLLING AND TUBE MANUFACTURING

M. Raudensky and J. Horsky
THERMAL MODEL OF ROLLS AND SHEETS IMPROVEMENT BY EXPERIMENTAL STUDY OF COOLING 247

P. Mantyla, R. Korhonen and N.-G. Jonsson
IMPROVED THICKNESS AND SHAPE ACCURACY WITH ADVANCED PASS SCHEDULING IN PLATE ROLLING 255

J. Mischke and J. Jonca
SIMULATION OF THE ROLLER STRAIGHTENING PROCESS 265

W. Weronski and Z. Pater
SELECTION OF GEOMETRIC PARAMETERS OF TRANSVERSE WEDGE ROLLING TOOLS 273

A.A. Nefyodov
ABOUT SOME PROBLEMS OF HEAVY-SECTION MILL RECONSTRUCTION 281

Z. Rdzawski and A. Sadkowski
NEW APPROACH TO DEVELOPING A ROLLING TECHNOLOGY 287

S. Turczyn, Z. Kuzminski and A. Nowakowski
INVESTIGATION OF ROLLING OF AUSTENITIC STEEL SHEETS AND STRIPS AT ELEVATED TEMPERATURES 295

F. Micari
THREE-DIMENSIONAL COUPLED THERMO-MECHANICAL ANALYSIS OF HOT ROLLING PROCESSES 303

R.E. Johnson and R.E. Smelser
AN ASYMPTOTIC FORMULATION OF SHEAR EFFECTS IN TWO DIMENSIONAL ROLLING 311

W. Woldt, E. Bretschneider and T. Roth
MODERNIZATION OF THE ESW ROHRENWERKE GmbH TUBE MILL IN ESCHWEILER 319

J. Osika and W. Libura
MATHEMATICAL ROLLING OF TUBE COLD ROLLING IN PILGER MILL 325

W. Kubinski, J. Kazanecki and J. Starowicz
INVESTIGATION OF THE PRESS PIERCING MILL PROCESS 333

W.S. Hwang, N.H. Kim, H.S. Sohn and J.S. Lee
ELECTROMAGNETIC JOINING OF ALUMINUM TUBES ON POLYURETHANE CORES 341

FORGING, DRAWING AND EXTRUSION

S. Sheng and L.Y. Guo
PREFORM DESIGN OF AXISYMMETRIC FORGINGS BASED ON REVERSE SIMULATION TECHNIQUE OF DIE FORGING PROCESS 349

J. Jezierski
GEOMETRICAL ANALYSIS OF THE FORMING STEPPED SHAFTS BY COLD WORKING 357

S. Szczepanik
ANALYSIS OF DENSIFICATION AND STRAINS IN THE UNIAXIAL COMPRESSION OF SINTERED MATERIALS 365

J. Lukowski and F. Grosman
PLASTIC FORMING OF POROUS MATERIALS 373

L. Sadok, M. Packo, A. Skolyszewski and M. Ruminski
INFLUENCE OF THE SHAPE OF THE DIE ON THE FIELD OF STRAINS IN THE DRAWING PROCESS 381

J. Majta, J. Luksza and L. Sadok
THE ESTIMATION OF MECHANICAL PROPERTIES DISTRIBUTION IN PLASTIC WORKING PRODUCTS: EXAMPLE FOR THE DRAWING PROCESS 389

M. Kiuchi and R.-Q. Hsu
NUMERICAL SIMULATION OF DRAWING OF MULTI-CORES CLAD BARS 397

M. Gierzynska-Dolna and E. Krajewska-Binczyk
CRITERIA OF OPTIMIZATION OF EXTRUSION OF TITANIUM ALLOYS 405

SHEET FORMING

L. Sobotova and E.Spisak
THE INFLUENCE OF PRODUCTION OF THIN TINPLATED SHEET ON ITS FORMABILITY 411

S. Kapinski
INFLUENCE OF THE PUNCH VELOCITY ON DEFORMATION OF THE MATERIAL IN DEEP-DRAWN FLANGE 419

A. Hrivnak and L. Sobotova
THE INFLUENCE OF THE DEFORMATIONAL AGEING AND THE CONDITIONS OF STRESS ON THE PROPERTIES OF THE DEEP-DRAWING STEEL SHEET 425

D. Banabic and S. Valasutean
THE EFFECT OF VIBRATORY STRAINING UPON FORMING LIMIT DIAGRAM 431

E. Doege and S. Schulte
DESIGN OF DEEP DRAWN COMPONENTS WITH ELEMENTARY CALCULATION METHODS 439

Z. Tan, B. Persson and C. Magnusson
AN EMPIRIC MODEL FOR CONTROLLING SPRINGBACK IN V-DIE BENDING OF SHEET METALS 449

J.Z. Gronostajski and Z.Zimniak
THE EFFECT OF CHANGING OF HETEROGENEITY WITH STRAIN ON THE FORMING LIMIT DIAGRAM 457

UNCONVENTIONAL FORMING PROCESSES

M. Plancak, A. Bramley and F. Osman
NON-CONVENTIONAL COLD EXTRUSION 465

A.C.M. Sousa, J. Selih, A.G. Gerber and J.G. Lenard
HEAT AND FLUID FLOW SIMULATION OF THE METAL-DRAG SINGLE-ROLL STRIP CASTING PROCESS 473

W. Lapkowski, M.Pietrzyk and J.Sinczak
BEHAVIOUR OF METAL ALLOYS DURING PLASTIC DEFORMATION IN PARTLY LIQUID STATE 481

A. Pasierb and A. Wojnar
AN EXPERIMENTAL INVESTIGATION OF DEEP DRAWING AND DRAWING PROCESSES OF THIN-WALLED PRODUCTS WITH UTILIZATION OF ULTRASONIC VIBRATIONS 489

H.-J. Marczinski
AXIAL CLOSED-DIE ROLLING, AN ECONOMIC HOT-FORMING METHOD DUE TO HIGH PRECISION AND FLEXIBILITY 495

MICROSTRUCTURE EVOLUTION

Z. Liu, G. Wang, S. Han, Q. Zhang, D. Ma and G. Wu
THE DEVELOPMENT OF THE TWO-DIMENSIONAL TEMPERATURE - MICROSTRUCTURE EVOLUTION COUPLING COMPUTER MODEL FOR HOT STRIP ROLLING PROCESS 503

M. Glowacki, Z. Kedzierski, H. Kusiak, W. Madej and M. Pietrzyk
SIMULATION OF METAL FLOW, HEAT TRANSFER AND STRUCTURE EVOLUTION DURING HOT ROLLING IN SQUARE-OVAL-SQUARE SERIES 509

W. Libura and J. Zasadzinski
THE INFLUENCE OF STRAIN GRADIENT ON MATERIAL STRUCTURE DURING EXTRUSION OF THE AlCu4Mg ALLOY 517

F. Colonna, E.Massoni, S.Denis, J.-L. Chenot, J.Wendenbaum and E. Gauthier
ON THERMO-ELASTIC-VISCOPLASTIC ANALYSIS OF COOLING PROCESSES INCLUDING PHASES CHANGES 525

T. Welo, S. Skjervold, O. Jensrud and K. Pedersen
COLD FORGING AND GRAIN SIZE CONTROL IN AN Al-1.2wt% Si ALLOY 533

AUTOMATIC CONTROL OF ROLLING MILL DRIVES

R. Koziol and J. Sawicki
SOME PROBLEMS IN ANALYSIS AND SYNTHESIS OF ROLLING MILLS CONTROL SYSTEMS 541

M. Tondos
OBSERVERS FOR ROLLING MILL DRIVES WITH ELASTIC SHAFTS 547

Z. Mikos
POSSIBILITIES OF APPLICATIONS OF THE HIGH POWER CYCLOCONVERTER DRIVE IN METALLURGY 555

H. Kayser
ELECTRONIC EQUIPMENT FOR THE PREVENTION OF DAMAGES IN ROLLING MILL SYSTEMS 561

H. Widlok
CONTROL SYSTEM OF MATERIAL FLOW IN HOT ROLLING-MILL DRIVE 567